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ILLINI SOYBEANS

By C. M. WOODWORTH



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SUMMARY

1. The Illini soybean is a single plant selection from the A. K. variety.
2. The Illini is primarily a seed type, early maturing, (105 days) stands well, and holds its seed well. It has white flowers, gray pubescence, yellow seeds with light brown hilum or seed scar, and yellow to light brown pods. These characters enable one to distinguish and rogue mixtures easily, and thus to keep the variety pure.
3. In yield tests the Illini has given significant increases over the Dunfield and Ebony varieties on the Northwest rotation. For the five-year period 1924 to 1928, the Illini yielded 6.1 bushels per acre above Dunfield, the next highest yielder in this test, and 11.4 bushels above Ebony (Table 4).
4. Under the much less favorable conditions from the soil fertility standpoint on the South Central rotation the Illini, in a three-year test, yielded 1.8 bushels more than Dunfield, 4.6 bushels more than Ebony, and one bushel more than Manchu (Table 5).
5. In oil content the Illini compares favorably with other varieties of soybeans. As an average of five years it gave an analysis of 19.78 percent; the Manchu, 18.54 percent (Table 6). The oil content was found to vary widely for Illini crops produced at different places in the state, ranging from 18.95 percent to 21.02 percent (Table 8).
6. Many growers reported good yields in 1927 and 1928 from the Illini soybean. Practically all of them were very well satisfied with it.
7. Illini seems to be best adapted to central Illinois conditions. Growers are advised, however, to make their own tests to determine whether this variety is better for their soils and climatic conditions than the variety or varieties they have been growing.

ILLINI SOYBEANS

By C. M. WOODWORTH, Associate Chief in Plant Breeding

Soybean varieties as ordinarily grown are of many different types. These types may be plants of different varieties that have been brought in by mixing in the drill or threshing machine; they may have arisen as heritable variations (mutations) thru some unknown cause; or finally, they may be the result of natural crossing between the typical and atypical forms growing side by side in the same field. All types within such a mixture are not of equal value or productiveness. Some are better than others. By selecting within such a population of plants, regardless of the manner in which the mixtures occurred, the better yielding types can be isolated.

Illini Developed From A. K.

The Illini soybean has been developed from a variety known as A. K., facetiously called "All Kinds" because as commonly grown it is a mixture of so many types. Variations in color of flower, pubescence, pod, and seed, in height of plant, maturity, and yield, can be commonly observed. The variety has been a good yielder both of seed and of hay and is preferred by many growers particularly for planting with corn.

Because of the general excellence of this variety and its marked variability, it was considered to be a good variety to use as foundation stock from the standpoint of improvement by breeding. Accordingly in the fall of 1920 a group of plant selections was made from the A. K. variety, and in 1921 a plant row was grown from each. One of these attracted attention because of its uniformity and apparent productiveness of seed. Several plants were selected from this row and tested separately in rows the following year; and as the plants bred true to type, the progenies were composited to make up a sufficient amount of seed for a small plot test in 1923. This lot of seed produced by the descendants of a single plant (1315-7) constituted what is generally called a pure line. For a time this line was designated as "A. K. 3," but later was given the name "Illini."

Illini Primarily a Seed Type

The Illini soybean is primarily a seed type rather than a hay type (Figs. 1, 2). As ordinarily grown, the plants do not branch much, but when seeds are spaced in the row, there is much branching and a bushy type of plant is produced. The plant is well-podded from within a few inches of the ground to the tip of the stem. The tips of the stems are fine but not twining. The plants stand well

during the greater part of their vegetative growth, but later as the weight increases owing to seed development, and because of rains and



FIG. 1.—PLANT OF AN ILLINI SOYBEAN

The Illini is more a seed type than a hay type of plant. Some idea of its size is suggested by the lines in the background, which were a foot apart. (This plant was grown in a field and placed in the pot merely for convenience in making the photograph.)

strong winds, they tend to lodge. When the leaves have dropped, however, the stems straighten and become more erect, thus facilitating the harvest.

Illini Classed as 105-Day Bean

Ability to mature properly before frost is an important characteristic of a soybean variety. If the variety is too late, it is killed by frost, and the quality and germination of the seed are lowered. On

the other hand, if it is too early, it stops growing and comes to maturity days or weeks before there is any danger of frost, and in



FIG. 2.—AN ILLINI SOYBEAN PLANT
WITH LEAVES REMOVED

The high proportion of three-seeded pods is quite evident.

consequence, the full yielding capacity is not attained, for the season has not been fully utilized for growth and seed production.

In central Illinois, the Illini matures relatively early. Every year it has ceased growing before a killing frost. If seeded by or before May 25, it can usually be harvested in time to prepare the field for seeding winter wheat. The Illini can be classed as a 105-day soybean.

Some Characteristics of the Illini Plant

The Illini variety holds its seed after ripening very well, and it mottles very little or not at all under the soil and climatic conditions at the University Farm, Urbana, Illinois. It has a number of recessive characters. The flowers are white, the pubescence or plant hairs gray, the pods yellow to light brown, the seeds yellow, and the hilum or seed scar a light brown. These characters, being recessive, enable one to detect mixtures carrying the corresponding dominants, such as purple flowers, brown pubescence, dark pods, green seeds, and black hilum. Rogueing can therefore be thoroly and effectively done, and for this reason the variety is relatively easy to keep pure. Seeds are medium size (2,864 per pound) and are oblong to round.

In general appearance and characteristics the Illini resembles the Dunfield variety, tho the latter has a lighter colored pod.

Plant Measurements

A careful study was made of about 100 plants that were grown in rows 28 inches apart and cultivated twice during the growing season (1926). The soil was good, probably more fertile than most of the soil of the same type in central Illinois. The average height of plant was 38 inches, the average number of branches, 3.1, and 16 was the average number of joints or nodes on main stem per plant. The average length of stem between the joints was 2.375 inches. These numerical results cannot be taken as absolute, since they are affected greatly by soil and seasonal conditions and method and rate of planting.

Pods Borne Well Off the Ground

The height on the stem at which the lowest pods are borne is important from the harvesting standpoint. If the pods are too close to the ground, they are left in the field and in consequence there is considerable loss. The binder or the combine cannot run low enough to get them. A limited study of 50 other selections from the A. K. variety growing in the same field revealed some outstanding differences in this characteristic, some strains bearing their pods twice as high from the ground as others. Measurements on the Illini plants showed that, on the average, the lowest pod was 5.6 inches from the ground.

Pods Mainly Three-Seeded

The Illini plants studied produced a majority of three-seeded pods. The 4,176 pods examined on 114 plants were classified on the basis of number of seeds per pod. Results are shown in Table 1.

It is obvious that the number of seeds per pod may have a marked influence on the yield of seed per plant or per acre. If two

plants produce the same number of pods, but the pods of one are predominantly two-seeded, and those of the other three-seeded, the latter will give the more seeds, and therefore the better yield provided there is no difference in seed size. This is made clear from counts given in Table 2, on two plants, each belonging to a different

TABLE 1.—SEEDS PER POD FOUND ON 114 ILLINI SOYBEAN PLANTS, 1926

Class	Number of pods	Percent
One-seeded pods.....	326	7.80
Two-seeded pods.....	1 426	34.15
Three-seeded pods.....	2 415	57.83
Four-seeded pods.....	9	.22
Total.....	4 176	100.00

TABLE 2.—PROPORTION OF 2-SEEDED AND 3-SEEDED PODS BORNE ON ONE PLANT FROM EACH OF TWO STRAINS OF A. K.

Strain	1-seeded pods		2-seeded pods		3-seeded pods		Total pods	Total seeds
	No.	perct.	No.	perct.	No.	perct.		
No. 113.....	6	14.3	30	71.4	6	14.3	42	84
No. 114.....	9	20.0	14	31.1	22	48.9	45	103

TABLE 3.—SEEDS PER POD FOUND ON 2,500 ILLINI SOYBEAN PLANTS, 1928

Class	Number of pods	Percent
One-seeded pods.....	765	1.30
Two-seeded pods.....	11 889	20.21
Three-seeded pods.....	45 743	77.75
Four-seeded pods.....	437	.74
Total.....	58 834	100.00

strain of the A. K. variety. Thus, tho the plant belonging to strain 114 bore only 7 percent more pods than the other, it bore 23 percent more seed. Those types, therefore, whose pods are predominantly 3-seeded are the best yielders, other things being equal. Probably this is one way of accounting for the high yielding power of the Illini soybean.

Further data showing the pods of the Illini to be predominantly 3-seeded were secured in 1928 (Table 3). One hundred progeny

rows were grown from as many single plant selections of this variety made in the fall of 1927. Twenty-five plants were taken at random from each row and the pods were picked off and then classified according to the number of seeds per pod. While in 1926, only 57.83 percent of the pods were 3-seeded, in 1928, 77.75 percent were 3-seeded. This is a striking difference. Probably it is due somewhat to seasonal influences. Probably also soil and spacing affected it considerably. Plants grown in 1926 were on more fertile soil than those grown in 1928, but the latter plants had more room in which to grow.

Yields in Test Plots

Usually the most important characteristic of a new strain is its yield. If the yield is high, the strain has great economic possibilities; if the yield is low, it is not given serious consideration unless it possesses some other character of outstanding value, such as high quality or early maturity, which can be combined with still other desirable characters in crosses.

The Illini soybean has been tested for seed yield in field plots at Urbana for the five seasons, 1924 to 1928. Results obtained in comparison with Ebony as the check and Dunfield as the highest yielding variety aside from Illini on the Northwest rotation at Urbana are shown in Table 4. Illini is 6.1 bushels above Dunfield in average yield and 11.4 bushels above Ebony. These differences, when tested by Student's method¹ are both found to be statistically significant. The odds that Illini is a better yielder than Dunfield are 44:1 and the odds that Illini is a better yielder than Ebony are 72.5:1. That is to say, under conditions similar to those of the trials, Illini in 44 out of 45 trials would be expected to yield better than Dunfield, and in 72 out of 73 trials would be expected to yield better than Ebony.

The Illini soybean has been tested only three years on the South-central rotation at Urbana. This is a rotation of three years corn and one year soybeans. It is an undesirable rotation from many standpoints, and the yields of soybeans are much lower than those on the Northwest rotation (corn, potatoes, soybeans, alfalfa). In the comparisons given in Table 5, the yields of Manchu are also included. When Student's method is applied to these data, the odds in favor of Illini are much lower than in the case of the data in Table 4. The odds that Illini is a better yielder than Dunfield are 9:1, a better yielder than Ebony 2:1, and than Manchu 7:1. Under the conditions of this experiment, then, Illini would be expected to yield better than Dunfield in 9 out of 10 trials, than Ebony in 2 out of

¹Student. The probable error of a mean, *Biometrika* 6, 1-25, 1908. Love, H. H., and Brunson, A. M. Student's method of interpreting paired experiments, *Jour. Amer. Soc. Agron.* 16, 60-68, 1924.

3 trials, and than Manchu in 7 out of 8 trials. Ebony was very inconsistent in yield. In 1926 it gave 3.4 bushels more than Illini and in 1927, 8.8 bushels less. Furthermore in 1928 it was killed by frost and no crop was obtained. The comparative inconsistency in yield of the Ebony variety and its late maturity resulting in probable total losses by frost, are two undesirable qualities. Even tho the odds are too small to justify the statement that Illini is a better yielder than Ebony under these conditions, the above mentioned qualities are sufficiently undesirable to eliminate Ebony from the

TABLE 4.- YIELDS OF SEED FROM ILLINI, DUNFIELD, AND EBONY FOR THE FIVE-YEAR PERIOD, 1924-1928; NORTHWEST ROTATION,
AGRONOMY SOUTH FARM, URBANA
(Bushels per acre)

Variety	1924	1925	1926	1927	1928	Average
Illini.....	40.2	50.9	40.5	40.5	38.5	42.1
Dunfield.....	36.0	37.5	38.5	32.1	35.7	36.0
Ebony.....	23.5	32.1	33.4	26.8	37.7	30.7

TABLE 5.- YIELDS OF SEED FROM ILLINI, DUNFIELD, EBONY, AND MANCHU,
1926-28; SOUTH-CENTRAL ROTATION, AGRONOMY SOUTH FARM, URBANA
(Bushels per acre)

Variety	1926	1927	1928	Average
Illini.....	29.3	30.6	35.9	31.9
Dunfield.....	28.2	26.9	35.3	30.1
Ebony.....	32.7	21.8	Frosted	27.3 (2 years only)
Manchu.....	27.1	29.0	36.5	30.9

comparison. The odds that Illini is a better yielder than either Dunfield or Manchu are too low to give reasonable certainty of this fact. It is worthy of note, however, that Illini was never exceeded in yield by Dunfield and only once by Manchu.

The marked difference in odds in favor of Illini for yield tests on the two above mentioned rotations indicates that Illini responds better to high soil fertility than does either Ebony or Dunfield.

Illini Growers Report Good Yields

Good reports on yield were received from Illini growers in 1927, some reporting yields as high as 30 bushels to the acre.

In order to obtain information on the performance of Illini in 1928, a questionnaire was mailed to all Illini growers that could be reached. Replies were received from 73 growers located in 31

different counties in Illinois, and in addition from one grower in Missouri and one in Wisconsin. Quite variable yields were reported ranging from 2 bushels per acre obtained under very unfavorable conditions in southern Illinois to 44 bushels per acre. In general, most growers were well pleased with the performance of Illini beans, many mentioning high yield as one of their outstanding qualities.

Other qualities emphasized by the growers were earliness, erectness, ability to hold seeds well, ease of harvesting and threshing, and excellent quality of the seed. A few growers spoke of the Illini soybean as an all-purpose or "dual" purpose soybean. One grower stated, however, that it was too coarse for hay; another preferred Sable as a hay bean. Only one grower, out of about 70 who expressed an opinion concerning the value of Illini for their conditions, was unfavorable, stating that on his land (Macoupin county) this variety was not as good as others. In general, however, the reports were so favorable, many in fact, enthusiastic, that it is felt that Illini is a valuable addition to the list of varieties grown in Illinois.

Oil Content Compares Favorably With Other Varieties

The Illini soybean, in its oil content, compares favorably with other varieties. Comparisons with Manchu are given in Table 6. The average difference in favor of Illini is 1.24 percent. The odds, calculated by Student's method, are 12:1 that this difference is real and not due to errors of sampling. Hence in 12 out of 13 similar comparisons we should expect the Illini to exceed the Manchu in oil content. The relatively low odds may be accounted for largely by the small differences between the varieties in 1924, 1927, and 1928.

In 1927 analyses were made of Illini and a few other varieties produced on the South-central and Northwest rotations at Urbana (Table 7). Definite conclusions cannot, of course, be drawn from a single year's comparisons. It is to be noted, however, that Illini, while not the highest in oil content in either rotation, is not the lowest. On the basis of the data presented in Tables 6 and 7, we probably are justified in saying that in oil content Illini beans are as high as, but no higher than, certain of the well-known standard varieties.

Too much dependence should not be placed on a single oil analysis for a particular season or location. Results in Table 5 show marked differences for different seasons. Climatic conditions in certain seasons seem to be particularly favorable for producing high oil soybeans and in other seasons the reverse is true. Furthermore, considerable variation is found in analyses of the same variety grown in different places the same season. Data on the Illini variety are given in Table 8. While these results are inconclusive, similar findings for other varieties grown at various places have been reported by Piper and Morse¹ and Stark.²

Illini Adapted Best to Central Illinois

Illini seems to be best adapted to the central part of Illinois, tho it does fairly well in the south-central part. In these sections it matures about the same time as, or a little earlier than, the Manchu.

TABLE 6.—PERCENTAGE OF OIL IN ILLINI AND MANCHU VARIETIES, 1924-1928; PLANT BREEDING PLOTS, AGRONOMY SOUTH FARM, URBANA

Variety	1924	1925	1926	1927	1928	Average
Illini.....	17.81	22.20	19.93	18.32	20.65	19.78
Manchu.....	17.68	18.45	18.04	17.96	20.57	18.54

TABLE 7.—COMPARISONS IN OIL CONTENT BETWEEN ILLINI AND OTHER VARIETIES IN 1927: AGRONOMY SOUTH FARM, URBANA

Variety	Rotation	Oil content
		perct.
Illini.....	South-central	20.66
Elton.....	South-central	20.69
Wea.....	South-central	21.22
Manchu.....	South-central	18.95
Illini.....	Northwest	18.95
Dunfield.....	Northwest	20.37
Ebony.....	Northwest	17.31

TABLE 8.—VARIATION IN OIL CONTENT OF ILLINI SOYBEANS GROWN AT DIFFERENT PLACES IN ILLINOIS, 1927

Location	Oil content
	perct.
South-central rotation, Agronomy South Farm, Urbana	20.66
Northwest rotation, Agronomy South Farm, Urbana..	18.95
Girard, Illinois.....	20.48
Bowen, Illinois.....	21.02
Homer, Illinois.....	19.28

In the northern part of the state Illini appears to be too late for best results, as indicated by results on the DeKalb experiment field, DeKalb, Illinois. A grower in Knox county stated that Illinis were good for hay but rather late for seed. However, a grower in Peoria county found them to be three weeks earlier than the Manchu, and a grower in LaSalle county stated they were as well adapted to his

¹Piper, C. V., and Morse, W. J. *The soybean*. McGraw-Hill Book Co. 1923.

²Stark, R. W. Environmental factors affecting the protein and the oil content of soybeans and the iodine number of soybean oil. *Jour. Amer. Soc. Agron.* 16 (10), 636-646. 1924.

conditions as other leading varieties. If the Illinis are grown in the northern part of the state, they should be planted as early as practicable.

Illini soybeans appear to do best on a soil which is in a fair state of fertility. Limited data indicate that they respond rather readily to soil treatment. A grower in Mason county stated that they seemed to do well on sand. On land that is too rich, they have a tendency to lodge, as indicated by the experience of a grower in Morgan county. Too rich land was cited by a grower in Adams county as the cause for the stems twining excessively. Limited tests in Effingham county on treated land indicated that Haberlandt and Morse were better adapted to those conditions than Illini.

Growers Advised to Make Own Tests

Since there is such a wide variation in soil and climatic conditions in Illinois, it is difficult, if not impossible, to outline definitely the sections and soils to which this variety is adapted. Perhaps the best advice to give the prospective grower is to secure a few bushels of seed and test them in comparison with the leading variety or varieties in the locality. Only in this way can the grower satisfy himself that he is raising the soybean that is best adapted to his particular set of conditions.



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